

## CLAIMS

1 1. An echo canceller adapted for use in a communication system that includes a hybrid circuit,  
2 said echo canceller comprising:

3 an adaptive digital filter that generates an estimated echo signal  $\hat{z}[k]$  in response to (i) a  
4 sampled input data sequence  $x[k]$  and (ii) an error signal sequence  $e[k]$  indicative of the  
5 difference between a near end signal sequence  $y[k]$  and the estimated echo signal  $\hat{z}[k]$ , wherein  
6 said adaptive digital filter computes filter coefficients based upon said error signal sequence  $e[k]$   
7 using a stochastic quadratic descent estimator that employs a dynamically adjustable step size  
8 vector  $\underline{\mu}[k]$  and said adaptive digital filter comprises means for computing said dynamically  
9 adjustable step size vector  $\underline{\mu}[k]$  of the form  $\underline{\mu}[k+1] = \underline{\mu}[k] + \alpha \underline{\phi}[k] \cdot \underline{x}[k] e[k] \underline{\mu}_{\max}$ , where  
10  $\underline{\phi}[k+1] = \underline{\phi}[k] \cdot (1 - \underline{\mu}[k] \cdot \underline{x}^2[k]) + e[k] \underline{x}[k]$  and  $\alpha$  is a scalar.

1 2. The echo canceller of claim 1, wherein said stochastic quadratic descent estimator  
2 comprises a least mean square (LMS) estimator that includes said dynamically adjustable step size.

1 3. An echo canceller adapted for use in a communication system that includes a hybrid circuit,  
2 said echo canceller comprising:

3 an adaptive digital filter that generates an estimated echo signal  $\hat{z}[k]$  in response to (i) a  
4 sampled input data sequence  $x[k]$  and (ii) an error signal sequence  $e[k]$  indicative of the  
5 difference between a near end signal sequence  $y[k]$  and the estimated echo signal  $\hat{z}[k]$ , wherein

6 said adaptive digital filter computes filter coefficients based upon said error signal sequence  $e[k]$   
7 using a stochastic quadratic descent estimator that employs a dynamically adjustable step size  $\mu[k]$   
8 and said adaptive digital filter comprises means for computing said dynamically adjustable step size  
9  $\mu[k]$  of the form  $\mu[k+1] = \mu[k] + \xi[k]$ , where  $\xi[k]$  is an empirically derived set of values .

1 4. The echo canceller of claim 3, wherein said stochastic quadratic descent estimator  
2 comprises a least mean square (LMS) estimator that includes said dynamically adjustable step size.

1 5. An integrated circuit that includes an echo canceller adapted for use in a communication  
2 system that includes a hybrid circuit that provides a return signal, said echo canceller comprising:

3 an adaptive digital filter that generates an estimated echo signal  $\hat{z}[k]$  in response to (i) a  
4 sampled input data sequence  $x[k]$  and (ii) an error signal sequence  $e[k]$  indicative of the  
5 difference between a near end signal sequence  $y[k]$  and the estimated echo signal  $\hat{z}[k]$ , wherein  
6 said adaptive digital filter computes filter coefficients based upon said error signal sequence  $e[k]$   
7 using a stochastic quadratic descent estimator that employs a dynamically adjustable step size  
8 vector  $\underline{\mu}[k]$  and said adaptive digital filter comprises means for computing said dynamically  
9 adjustable step size vector  $\underline{\mu}[k]$  of the form  $\underline{\mu}[k+1] = \underline{\mu}[k] + \alpha \underline{\phi}[k] \cdot \underline{x}[k] e[k] \underline{\mu}_{\min}^{\max}$ , where  
10  $\underline{\phi}[k+1] = \underline{\phi}[k] \cdot (1 - \underline{\mu}[k] \cdot \underline{x}^2[k]) + e[k] \underline{x}[k]$  and  $\alpha$  is a scalar.

1 6. The integrated circuit of claim 5, wherein said stochastic quadratic descent estimator  
2 comprises a least mean square (LMS) estimator that includes said dynamically adjustable step size.

1 7. A digital signal processor that includes executable program instructions to provide an echo

2 canceller adapted for use in a communication system which includes a hybrid circuit that provides  
3 a return signal, said echo canceller comprising:

4 an adaptive digital filter that generates an estimated echo signal  $\hat{z}[k]$  in response to (i) a  
5 sampled input data sequence  $x[k]$  and (ii) an error signal sequence  $e[k]$  indicative of the  
6 difference between a near end signal sequence  $y[k]$  and the estimated echo signal  $\hat{z}[k]$ , wherein  
7 said adaptive digital filter computes filter coefficients based upon said error signal sequence  $e[k]$   
8 using a stochastic quadratic descent estimator that employs a dynamically adjustable step size  
9 vector  $\underline{\mu}[k]$  and said adaptive digital filter comprises means for computing said dynamically  
10 adjustable step size vector  $\underline{\mu}[k]$  of the form  $\underline{\mu}[k+1] = \underline{\mu}[k] + \alpha \underline{\phi}[k] \cdot \underline{x}[k] e[k] \underline{\mu}_{\min}^{\mu_{\max}}$ , where  
11  $\underline{\phi}[k+1] = \underline{\phi}[k] \cdot (1 - \underline{\mu}[k] \cdot \underline{x}^2[k]) + e[k] \underline{x}[k]$  and  $\alpha$  is a scalar.

1 8. The echo canceller of claim 3, wherein said stochastic quadratic descent estimator  
2 comprises a least mean square (LMS) estimator that includes said dynamically adjustable step size.